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All optical networks: A catalyst for sustainable energy planning and the 'key' for aligning the objectives of digital transformation and sustainability agendas

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Climate change is a global challenge and the development of a low carbon economy becomes a top priority worldwide. To this end 189 countries have joined the Paris Agreement on climate change aiming at limiting global warming (preferably to 1.5 degrees Celsius compared to pre-industrial levels) and the world's major economies have all made commitments to carbon neutrality.

Implementation of the Paris Agreement requires economic and social transformation.

The European Green Deal sets the principles for building a new economic model to support the transformational change required to face the climate change challenge. European Union aims at becoming the first climate neutral continent by 2050 and to achieve this, gas emissions should be reduced by at least 55% by 2030, compared to 1990 levels. In June 2021, the European Council and the European Parliament adopted legislation that includes these objectives into Europe's first Climate Law.

The last five years there has been an increasing awareness of the potential environmental effects of ICT. The CO2 footprint of ICT, TV and other consumer electronics in 2020 has been 1.0-1.7 billions of tonnes of global CO2 equivalent emissions (GtCO2e) which corresponds to 1.8-2.9% of the global Green House Gas emissions. The need for reducing ICT CO2 footprint becomes a necessity and in this direction the International Telecommunications Union (ITU) has made the reduction of ICT carbon emissions by more than 45% a target for 2030.

Communication networks contribute significantly to the ICT's sector (excluding TV) carbon footprint and for 2020 this contribution is estimated to be in the order of 20%-35%. The reduction of the broadband networks energy dissipation and the relevant CO2 emissions becomes another key objective.

Fiber broadband access networks (FTTH/FTTP) offer several advantages: higher speeds, lower latencies, smaller cost per speed unit, increased reliability and scalability while being the most technological secure and in-the-field validated broadband technology. On top of these advantages and even more important fiber networks is the most energy efficient network technology because of the reduced role played by active equipment compared with legacy technologies for which active equipment is extensively used to increase network performance.

Recent research in Germany has proven that the average annual energy consumption per user of VDSL2 copper access technology network is 16 kWh while the annual emissions for one million users are 6400 tons of carbon dioxide. For GPON and XG-PON fiber optic technologies, the corresponding numbers, according to the study, appear reduced to only 1/16 !.

A key point in the European Green Deal is that ICT saves more emissions through the efficiencies it brings in other sectors than it produces through its own energy consumption. ICT's net effect on global emissions depends on the extent to which ICT substitutes more traditional, carbon-intensive activities – i.e. the Green Digital Transformation.

Fiber is the most energy efficient network technology but this is by no means the only way this technology contributes towards reducing CO2 emissions. Fiber networks can be used as the implementation platform for a vast array of other carbon intensive services and applications leading to further reduction of energy dissipation and CO2 emissions (over conventional realization of these services and applications). Fiber connectivity gives people the same levels of access to everything they can do online in an office, remotely from home. And this can heavily reduce commuting trips and the number of kilometres travelled by car saving thousands of tons of CO2 emissions. A study by Telework Research Network suggests that if half the UK workforce worked from home just twice each week it would reduce UK transportation emissions by 4%, equivalent to taking 2.5 million cars off the road. Doctors can treat patients remotely using video links and monitoring. A study in Sweden found that by replacing physical visits with tele-medicine appointments, a 40–70 times reduction in carbon emissions was achieved.

Fiber networks can even allow the energy and CO2 emissions reduction of other telecommunication networks technologies such as 5G.

5G is also expected to contribute significantly to the reduction of the energy dissipation in several socio-economic activities, as well as the network's own power consumption, helping us to reduce our environmental footprint and contribute towards building sustainable and environmentally friendly telecommunication networks. A prerequisite to meet this goal is to exploit the novel capabilities 5G brings in network design, abandoning the traditional radio deployment architectures of 3G and 4G networks. More specifically, big macro cells that used to cover hundreds of users at the same time need to progressively become 'a thing of the past'. The focus should now shift to Microcells (serving 200 users) and Picocells (serving 50-60 users) that will be deployed densely in residential areas and will enable operating very low power RANs, since their signals will not have to travel for long distances or cross buildings/other physical obstacles to reach receivers at road level.

This will allow us to reduce the transmitted power (at radio level) by four times, and network overall power consumption by 80 - 90%, enabling the development of 'green' cells/base stations, which could even operate on renewable power collected at the point of use - with the help of a small power storage system.

This new dense and energy efficient wireless network architecture can be made possible only if a dense fiber network is in place to efficiently support backhauling.

In this context we should not forget the very important FTTH/FTTP – FTTA (Fiber to the Antenna) co-design for optimizing FTTH/FTTP deployment costs and 5G backhauling costs through infrastructure sharing, a measure that contributes to sustainability on its own.

What is the status today with regards to FTTH/FTTP deployment given all the benefits of fiber technology and the priorities in our digital transformation and environmental agendas?

FTTH/FTTP deployment has been intensified the last years in Europe and this trend is expected to continue given that 1 Gbps connectivity for all European households is one of the objectives of European Digital Decade 2030 on the infrastructure side (on top of climate/environmental ones).

According to the Broadband Coverage in Europe 2020 report of EC DG-Connect (issued in 2021 by Omdia) FTTP availability continued to grow in 2020 at an increasing rate compared to previous years, rising by 5.0 percentage points to pass 42.5% of EU homes (82 million in absolute terms) at the end of June 2020. Despite this increase, FTTP was taken over by DOCSIS 3.1 as the fastest growing broadband technology after holding this position for two years in a row in 2018 and 2019 and despite the 5.0 percentage point growth compared to mid-2019, FTTP coverage remained lower than VDSL and cable modem DOCSIS 3.0. On the other hand FTTP coverage expanded more quickly than other fixed broadband technologies in rural areas. Rural FTTP availability increased by 6.1 percentage points, reaching 24.9% of rural EU households. This significant increase indicates increased focus of many European operators on deploying FTTP networks even in traditionally less profitable rural areas.

FTTH/FTTP is making good progress in Europe but still has to compete with copper-based networks from many incumbents and with DOCSIS 3.1 technology. In other parts of the world FTTH/FTTP network deployments make good progress as well and according to IDATE the top 5 countries in June 2021 in number of FTTH/FTTP subscriptions were China, Japan, Russia, USA and Brazil.

Policy and regulatory action is still required to further speed up the deployment of fiber networks (FTTH/FTTP) and achieve our ambitious objectives.

Our goal should be to formulate policies that will encourage investment for the development of fiber access networks (FTTH/FTTP), but will also support the demand side so that this infrastructure is accessible and long-term economically viable.

What does this mean and which should be our priorities?

1. **Copper switch off:** It is necessary to determine in a simple and transparent way the procedure / date of 'closure' of the copper network in each area in which a fiber optic access network becomes commercially available. The transition should be designed in such a way that **citizens and businesses** a) can equally ensure their access to these new networks and b) do not incur the relatively high costs associated with the development of the last measures (last mile) of these networks.
2. **Consider subsidies programmes to support the demand:** The transition to fiber networks is a two components problem. Network infrastructure deployment is one part. We equally need subscribers. Subsidies to support the demand side e.g in the form of vouchers for the consumers could definitely help especially in the first steps of the transition.

3. **The digitization of (public and non-public) services to citizens** is vital and recognized by the European Commission as one of the four main objectives of the Digital Decade 2030 framework. Modern network infrastructure is not an end objective itself but a means of serving citizens, business development, social and economic progress of each country.
4. **Fiber optics in apartment buildings and not on the streets**: It is necessary in the next period to prioritize the termination of fiber optics in homes, small businesses and apartment buildings, balancing the rapid development of fiber cables we see on the streets (homes passed) with the creation of real / final connections.

Last but not least: Highlighting the role of fiber networks in meeting the goals of both digital and green transitions is a key objective. Fiber networks are a catalyst for sustainable energy planning and can significantly help reducing the carbon footprint of our broadband access. Fiber optics are the most technologically secure and energy efficient solution for the development of new generation networks and are the 'key' for aligning the objectives of the European Digital Decade 2030 agenda with the Green Sustainability Agenda (Green Deal).